* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the ink jet recording device which the ink in which the energy generation component which gives the energy for making ink breathe out to ink was breathed out from the ink nozzle of these plurality using the recording head which put side by side two or more ink nozzles built in, respectively is made to reach a record medium, and forms an image.
[0002]
[Description of the Prior Art] Generally, image output units, such as a printer, a copying machine, and facsimile, are constituted so that the image which consists of a dot pattern on record media, such as paper and plastics sheet metal, may be recorded based on image information.
[0003] This kind of recording apparatus can be divided into an ink jet type, a wire dot type, a thermal type, a laser beam type, etc. by the recording method, and since the low noise, a low running cost, a miniaturization, and colorization have which easy advantage, the ink jet type of them is applied widely to a printer, facsimile, a copying machine, etc.
[0004] Since it consisted of ink jet recording devices so that regurgitation flight of the ink droplet (recording ink) might be carried out from the delivery of a recording head, this might be made to adhere to a record medium and it might record, stabilization of the ink regurgitation was required for filling the demand of high-speed record, high resolution, high image quality, the low noise, etc., and stabilization of the ink regurgitation was conventionally attained using the following means.
[0005] That is, the cap member which carries out capping of the delivery of a recording head was prepared near the home position of carriage etc., suction recovery action which attracts ink from the delivery of a recording head using this cap member, and cancels the poor regurgitation was performed, and capping of a delivery was performed in order to aim at desiccation prevention of the ink in a delivery.
[0006] Moreover, Myst generated at the time of the ink which has rebounded from the record medium near the delivery, or the regurgitation is accumulated as the ink regurgitation is carried out, this accumulated ink is connected with a delivery, and the poor regurgitation, such as non-regurgitation and a kink, may be caused. In order to prevent this, surface ink was wiped off by polyurethane rubber's etc. wiping the front face (face side) of a recording head, and carrying out wiping by the member. Although it wipes, a member wipes and it is based on the quality of the material or mechanical setups, in order to always maintain the engine performance, it is necessary to wipe and to make the front face of the member itself into clarification. The cleaning device in which the ink which wipes, presses a member against an absorber etc. as the means, and was scratched by wiping was made to absorb was established in many cases.
[0007] Although stabilization of the ink regurgitation is attained as mentioned above in the ink jet recording device, the grace of the image recorded has a large place depending on the engine performance of a recording head simple substance. The recording head is constituted by many deliveries so that the regurgitation of two or more ink can be carried out.

[0008] Drawing 16 is the sectional view of one ink nozzle. 1000 is a recording head body, and the place of an ink nozzle 1001 is a cavity and is filled with ink. 1002 is an electric thermal-conversion object (regurgitation heater), and 1003 is the delivery of ink.
[0009] Next, ink discharging in a recording head is explained using drawing 17 .
[0010] If it energizes on the electric thermal-conversion object (regurgitation heater) 1002 and it is made to generate heat, the ink currently referring to the regurgitation heater 1002 will be heated rapidly, and a bubble (bubble) 1004 will occur (drawing 17 (a)). This is called film boiling. If energization is continued at the regurgitation heater 1002, a bubble 1004 will expand further and will push aside ink in the direction of a delivery 1003 (drawing 17 (b)). With the vigor, as some ink 1005 projects from a delivery 1003 and it shows drawing 17 (c) as a result, an ink droplet 1005 is breathed out from a delivery 1003. In this case, an ink droplet 1005 is perpendicularly breathed out to the front face of the regurgitation heater 1002. Then, a bubble disappears by energization halt of the regurgitation heater 1002, an ink nozzle 1001 is again filled with ink by capillarity, and it returns to the condition which showed in drawing 16 .
[0011] Next, the actuation at the time of printing is explained using drawing 18 . In drawing 18 , 1000 is the recording head of an ink jet recording device, and in this case, since it is easy, it shall be constituted by eight nozzles 1007.
[0012] 1005 is the ink droplet breathed out by the nozzle 1007. The recording head body 1000 shall be scanned in the list and the direction of a right angle of a nozzle 1007 (scan), and shall form an image.
[0013] As shown in drawing 18 , it is the same discharge quantity from each nozzle 1007, and it is an ideal that each ink droplet 1005 is breathed out in the same direction. As shown in drawing 18 (a), the ideal regurgitation is performed, as shown in ** and drawing 18 (b), the dot to which magnitude was equal reaches the target on space, and the image which does not have concentration nonuniformity on the whole is obtained. When such, concentration distribution of the direction of a nozzle list of the dot which reached the target serves as homogeneity, as shown in drawing 18 (c).
[0014] However, in fact, the slight difference produced at the time of recording head manufacture processes, such as a configuration of the delivery 1003 of a recording head 1000 and variation of the regurgitation heater 1002, affected the discharge quantity and the discharge direction of ink which are breathed out, consequently generated the concentration nonuniformity of an image, and was degrading image grace.
[0015] For example, if it prints using the recording head which has the nozzle 1007 which has dispersion (called depend) in an ink discharge direction as shown in drawing 19 (a), the white muscle which is looked at by drawing 19 (b) and which cannot fill area factor 100% periodically will be met and formed in a head main scanning direction, and the black line to which the dot overlapped reverse beyond the need will occur. In this case, concentration distribution of the direction of a nozzle list of the dot which reached the target comes to be shown in drawing 19 (c).
[0016] Then, in order to solve such concentration nonuniformity, the multi-pass recording method shown in drawing 20 was adopted conventionally in many cases. A multi-pass recording method is printing n times by the data which set the amount of paper feeds to 1/n of a use nozzle, and were thinned out complementary in 1/n at the time of horizontal scanning, and 1 raster line is printed using the nozzle of plurality (n pieces).
[0017] Drawing 20 shows the record result by the multi-pass recording method which used the recording head 1000 with the variation shown in above-mentioned drawing 19 (a). Drawing 20 (a) shows the starting position of three scans (scan) by the recording head 1000. In this case, the record section for four nozzles is completed with two scans, i.e., a two pass.
[0018] That is, eight nozzles of a recording head 1006 are divided into two groups of the nozzle of four left, and the nozzle of four right, and what thinned out regular image data in abbreviation one half with one scan is recorded, and one group is that the group of another side embeds the dot of the image data of the remaining one half at the time of the 2nd scan, and completes printing of the record section for four nozzles.
[0019] Since the effect of the record image on the variation in each nozzle proper will be reduced by

half even if it uses a recording head with the variation in the regurgitation property for every nozzle as shown by drawing 19 (a) if this multi-pass recording method is used, the recorded image comes to be shown in drawing 20 (b), and a black line and a white muscle stop being conspicuous. Therefore, concentration distribution of the direction of a nozzle list of the dot which reached the target comes to be shown in drawing 20 (c), and concentration nonuniformity is considerably eased compared with drawing 19 (c).

[0020] Thus, according to multi-pass printing, the nonuniformity of the shade by the difference between the error of paper feed and the regurgitation property (discharge quantity, discharge direction) for every nozzle, the difference in the ink rate of absorption according to quality of paper further, etc. is canceled, and it becomes possible to raise image quality.

[0021]

[Problem(s) to be Solved by the Invention] Thus, by the multi-pass printing method, while there is profitableness that image quality can be improved, since the image of each Rhine must be formed by the scan of multiple times, printing time amount becomes long and it has the problem that a print speed falls.

[0022] Let it be a solution technical problem to offer the ink jet recording device which loses the muscle and spots at the time of image formation, and realizes high definition image formation, this invention having been made in consideration of such a situation, and realizing high-speed printing.

[0023]

[Means for Solving the Problem] In order to cancel the above-mentioned trouble, in this invention, the recording head to which the energy generation component which gives the energy for making ink breathe out to ink put side by side two or more ink nozzles built in, respectively is used. While putting side by side and arranging said at least two energy generation components to said each ink nozzle in the ink jet recording device which the ink breathed out from the ink nozzle of these plurality is made to reach a record medium, and forms an image Carry out drive control of said at least two energy generation components, and the energy generation component drive circuit which makes ink breathe out is prepared in the direction in which plurality differs from the ink nozzle concerned for every ink nozzle. While recording the ink discharge direction of each ink nozzle by which drive control is carried out in said two or more energy generation component drive circuits, it is characterized by having a discharge direction change means to make it change at random.

[0024] Said energy generation component drive circuit can change a discharge direction by shifting the energization initiation time of each energy generation component of the ink nozzle concerned.

[0025] Moreover, said energy generation component drive circuit can also change a discharge direction by changing the applied voltage of each energy generation component of the ink nozzle concerned.

[0026] Moreover, said energy generation component drive circuit can also change a discharge direction by changing the resistance welding time of each energy generation component of the ink nozzle concerned.

[0027]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained with reference to an accompanying drawing.

[0028] Drawing 1 shows the notional configuration of an ink jet recording device.

[0029] In this ink jet recording apparatus, it is fixed to the endless belt 201, and carriage 200 meets the guide shaft 202, and is movable. The endless belt 201 is wound around pulleys 203 and 204. The driving shaft of the carriage drive motor 205 is connected with the pulley 203. Therefore, carriage 200 meets the guide shaft 202 and a scanning scan is carried out by the rotation drive of a motor 205 in the both-way direction (the direction of A). On carriage 200, the ink tank IT as an ink container which contains the recording head 1 and ink in which two or more ink regurgitation nozzles were installed is carried.

[0030] Two or more ink deliveries installed in the conveyance direction of Form P are formed in the field which counters with the form P as a record medium at the recording head 1. It is open for free passage to each of two or more of these deliveries, an ink way is established in a recording head 1, and the electric thermal-conversion object which generates the heat energy for the ink regurgitation is

prepared in it corresponding to each ink way. An electric thermal-conversion object generates heat, makes ink by this produce film boiling by impressing an electric pulse according to drive data, and makes ink breathe out from the above-mentioned delivery with generation of the air bubbles by the film boiling. The common liquid room which is open for free passage common to these is established in each ink way, and this common liquid room is connected to the ink tank IT.

[0031] Moreover, the linear encoder 206 is formed in this equipment for detecting the migration location of carriage etc. That is, the linear scale 207 has extended along the migration direction of carriage 200, and the slit is formed in this linear scale 207 by regular intervals, such as 600 etc. pieces, in 1 inch. On the other hand, the detection system 208 and digital disposal circuit of a slit which have a light-emitting part and a photo sensor are prepared in carriage 200. Therefore, from an encoder 206, the positional information of the regurgitation timing signal which shows ink regurgitation timing, and carriage is outputted as carriage 200 is moved. If the regurgitation of the ink is carried out for every slit detection, it will become possible to perform printing of the resolution of 600dpi to a main scanning direction.

[0032] The detail paper P as a record medium is intermittently conveyed in the direction of arrow-head B which intersects perpendicularly with the scanning direction of carriage 200. The recording paper P is pinched by the roller unit 209,210 of the pair of the upstream, and the roller unit 211,212 of the pair of the downstream, and where fixed tension was impressed and the smoothness over a head 1 is secured, it is conveyed. The driving force to each roller unit is given by the form conveyance motor which is not illustrated in this case.

[0033] A print is made by the whole form P, repeating the print of width of face and delivery of Form P corresponding to the array width of face of the delivery of a head by turns with migration of carriage 200 by such configuration.

[0034] Carriage 200 stops at a home position if needed during the time of a recording start, or record. The cap member 213 which carries out capping of the regurgitation side side of each head is formed in this home position, ink is compulsorily attracted to this cap member 213 from a delivery, and the suction recovery means (un-illustrating) for preventing the blinding of a delivery etc. is connected to it.

[0035] Drawing 2 shows the example of a configuration of the control system of an ink jet recording device.

[0036] CPU100 will perform control, data processing, etc. of each part of a recording apparatus, if printing information is received from host equipment. The processing program about various procedure is memorized by ROM101, and RAM102 is used for it as a work area in the case of the procedure activation etc. That is, CPU100 processes the printing information received from host equipment using peripheral units, such as RAM102, based on the control program memorized by ROM101, and performs processing of changing into printing data.

[0037] Moreover, CPU100 outputs the above-mentioned drive data, i.e., the printing data, and the above-mentioned drive control signal of an electric thermal-conversion object to the head driver 103. The head driver 103 drives the electric thermal-conversion object of a recording head 1 based on the inputted drive data.

[0038] moreover -- CPU -- 100 -- carriage -- 200 -- a round trip -- migration -- carrying out -- making -- a sake -- carriage -- a drive motor -- 205 -- and -- record -- a form -- P -- conveying -- a sake -- a form -- conveyance -- (-- PF --) -- a motor -- 104 -- Motor Driver 105,106 -- minding -- respectively -- controlling .

[0039] The positional information of a regurgitation timing signal and carriage is inputted into the head driver 103 from the above-mentioned encoder 206.

[0040] According to drawing 3 - drawing 9 , the 1st operation gestalt of this invention is explained below the [1st operation gestalt].

[0041] Drawing 3 shows the notional configuration about one ink nozzle 10 prepared in a recording head 1. Two or more such ink nozzles 10 are installed by the recording head 1.

[0042] Two electric thermal-conversion objects (regurgitation heater) 3 and 4 are adjoined and formed in one ink nozzle 10 shown in drawing 3 , and each heaters 3 and 4 are driven with a separate driving signal.

[0043] These two heaters 3 and 4 are put in order in the direction B of paper feed, i.e., the side-by-side installation direction of two or more nozzles 10. 5 is an ink delivery and 2 is an ink supply way to which the ink from a common liquid room is led to a delivery 5.
[0044] In addition, in this case, although the discharge direction of a liquid ink drop showed the head structure of a perpendicular side shooter mold to the heater side, of course, the discharge direction of a liquid ink drop can apply this invention also to the parallel head structure of an edge shooter mold to a heater side.
[0045] In this 1st operation gestalt, it enables it to shift the energization initiation time of the driving pulse added to heaters 3 and 4, and ink discharging in that case is shown in drawing 4 .
[0046] First, as energization is first started by the heater 3, consequently it is shown in drawing 4 (a), the ink currently referring to the heater 3 is heated rapidly, and a bubble 6 (bubble) occurs.
[0047] As energization is started by the heater 4, consequently it is shown in drawing 4 (b) below, a bubble 6 expands further and extrudes ink 7 in the direction of the ink delivery 5.
[0048] Then, as shown in drawing 4 (c), an ink droplet 8 is breathed out in the direction of a dotted line from a delivery 5.
[0049] In this case, since it energizes previously at a heater 3 and a bubble 6 occurs on a heater 3 first, the force which pushes aside ink 7 on right-hand side a little occurs. After that, since the regurgitation heater 4 is also energized, a bubble grows up to be an ununiformity and ink 7 is extruded in the direction of a delivery 5 with this uneven bubble, but as a dotted line shows ink in the case of the regurgitation, it inclines and flies in the heater side-by-side installation direction.
[0050] Drawing 5 (a) - (c) shows various kinds of examples of an energization wave of two heaters 3 and 4, and drawing 6 (a) - (c) shows the situation of the ideal ink regurgitation by these three energization waves, respectively.
[0051] That is, when a heater 3 energizes a few early from a heater 4, as are shown in drawing 5 (a), and it shows drawing 6 (a), the discharge direction of ink shifts to the right for a while.
[0052] Moreover, since bubble (bubble) 6** will grow up to be homogeneity if energization initiation of a heater 3 and the heater 4 is carried out at coincidence as shown in drawing 5 (b), as shown in drawing 6 (b), straight flight of the ink is carried out in the direction of a continuous line.
[0053] Moreover, if a heater 3 energizes somewhat later than a heater 4 as shown in drawing 5 (c), as shown in drawing 6 (c), the discharge direction of ink will shift to the left for a while.
[0054] Thus, the discharge direction of ink is controllable by shifting slight energization initiation timing of two regurgitation heaters 3 and 4.
[0055] Below, drawing 7 is used and the situation of record using such an ink nozzle 10 is explained. In drawing 7 , two or more ink nozzles 10 mentioned above are put side by side to the recording head 1 of an ink jet recording device. In this case, a nozzle is made into eight pieces for convenience. 8 is the ink droplet breathed out by the nozzle 10. A recording head 1 is scanned in the list and the direction of a right angle (direction perpendicular to space) of a nozzle 10.
[0056] In this case, 4 dots of the amount of main scanning directions which show the ink discharge direction about the nozzle 10 of these plurality to drawing 7 (a) - (d) are made to change at random as one period.
[0057] Namely, record of 1 dot of main scanning directions is performed with a discharge direction as first shown in drawing 7 (a). Record of 1 dot of main scanning directions is performed with a discharge direction as shows the discharge direction of each ink nozzle 10 below to drawing 7 (b) changed at random. Record of 1 dot of main scanning directions is performed with a discharge direction as shows the discharge direction of each ink nozzle 10 below to drawing 7 (c) changed at random. Record of 1 dot of main scanning directions is performed with a discharge direction as shows the discharge direction of each ink nozzle 10 below to drawing 7 (c) changed at random. And record of Rhine of the width of face corresponding to two or more parts for a nozzle is performed by repeating the record which made one period a part for 4 dots of these main scanning directions.
[0058] Drawing 7 (e) shows the image formed as mentioned above, and drawing 7 (f) is concentration distribution of the direction of a nozzle list of the dot about this image which reached the target.

[0059] Since the knot for every scan also becomes random while according to such a recording method the impact area of ink will shift at random, will be printed within the limits of predetermined and being able to ease a muscle and spots by this, a bond muscle can also be mitigated and high-definition image formation becomes possible. Moreover, since two or more scans are not performed to one line like a multi-pass method, a print speed also goes up.
[0060] Below, drawing 8 shows the example of concrete circuitry of the heater drive circuit for changing at random the energization initiation timing about two heaters 3 and 4 of one ink nozzle 10 mentioned above. Drawing 9 is a timing diagram which shows the various signals used in the circuit of drawing 8 .
[0061] The circuit shown in this drawing 8 is incorporated in the head driver 103 shown in drawing 2 .
[0062] Two heaters 3 and 4 are turned on and off by FET 20 and 21.
[0063] In this heater drive circuit, the heater driving pulse signal DP for [as usual / one] carrying out a heater drive is outputted from a single-shot trigger circuit 25. The signal which specifies the pulse width of the heater driving pulse signal DP outputted from the printing data DT in which turning on and off of the dot concerned is shown, and the heat pulse width setting circuit 26, and the regurgitation timing signal from the encoder 206 mentioned above are inputted into the single-shot trigger circuit 25, and a single-shot trigger circuit 25 outputs the heater driving pulse signal DP of the predetermined pulse width for recording the dot concerned, and a frequency (refer to drawing 9 (a)) based on these input signals.
[0064] This heater driving pulse signal DP is a signal for carrying out the on-off drive of the one heater about one ink nozzle as usual, and is making two driving pulse signals DP3 and DP4 (drawing 9 (i), (j)) from which the energization initiation timing for driving two heaters 3 and a heater 4 shifted by the circuitry of the following newly prepared in from a single-shot trigger circuit 25 before FET 20 and 21.
[0065] The heater driving pulse signal DP outputted from a single-shot trigger circuit 25 is inputted into the data terminal of two steps of D type flip-flops (it is called Following FF) 27. The clock signal ck (refer to drawing 9 (b)) of 2Mhz(es) is inputted into the clock terminal of these two steps of FFs 27 and 28.
[0066] Therefore, the heater driving pulse signal DP will be latched to the timing which shifted to FFs 27 and 28 by one clock, and the pulse signals DP1 and DP2 from which it started from FFs 27 and 28 only for 500ns (1/2MHz), and timing shifted as a result will be outputted (refer to drawing 9 (c) and (d)).

[0067] Selection distribution are carried out at random and it is made to input into two FET 20 and 21 by the circuitry which explains these two pulse signals DP1 and DP2 below.
[0068] The random-number-generation circuits 30 and 31 generate the 1-bit random numbers RND1 and RND2, respectively (refer to drawing 9 (e) and (g)). These random-numbers outputs RND1 and RND2 are latched by FFs 32 and 33 to the start timing of the heater driving pulse signal DP, and are outputted as select signals R1 and R2 (refer to drawing 9 (f) and (h)).
[0069] The selection circuit 40 is constituted by two or more gate circuits. With the combination of "H" "L" of select signals R1 and R2 The selection distribution of the two pulse signals DP1 and DP2 are carried out, it operates so that it may output to two FET 20 and 21 as the driving pulse signal DP 3 for heater 3 drive, and a driving pulse signal DP 4 for heater 4 drive, and the actuation is as follows.
[0070] Condition (a) -- It is R1="H", and when R2 is "L", a signal DP 1 is chosen as DP3, a signal DP 2 is chosen as DP4, and a heater 4 is driven with the signal DP 2 with energization timing drive a heater 3 with the early signal DP 1 of energization timing, and late.
[0071] Condition (b) -- When R2 is "H", regardless of R1, a signal DP 1 is chosen as DP3 and DP4, and heaters 3 and 4 are driven with a signal DP 1.
[0072] Condition (c) -- It is R1= "L", and when R2 is "L", a signal DP 2 is chosen as DP3, a signal DP 1 is chosen as DP4, and a heater 4 is driven with the signal DP 1 with energization timing drive a heater 3 with the late signal DP 2 of energization timing, and early.
[0073] Thus, by generating a 1-bit random number and changing the energization initiation timing of two heaters 3 and 4 from the random-number-generation circuits 30 and 31 with this random number in the above-mentioned operation gestalt Since the ink discharge direction of two or more nozzles with which the recording head 1 was equipped is changed intentionally at random for every dot of a main

scanning direction, the record image of the same image quality as a multi-pass can be obtained substantially, without performing multi-pass printing.
[0074] In addition, the periods to which a discharge direction is changed are arbitration, such as not only a 1-dot unit but a 2-dot unit, an a large number dot unit, 1 raster line unit, etc.
[0075] The [2nd operation gestalt] Below, the 2nd operation gestalt of this invention is explained according to drawing 10 - drawing 12 .
[0076] With this 2nd operation gestalt, as shown in drawing 10 , the discharge direction is changed within the specified quantity by impressing electrical potential differences V3 and V4 different, respectively to two heaters 3 and 4.
[0077] If it energizes by V3>V4 as shown in drawing 10 (a), as previous drawing 6 (a) showed, the discharge direction of ink will shift to the right for a while.
[0078] Moreover, if it energizes by V3=V4 as shown in drawing 10 (b), as previous drawing 6 (b) showed, and the continuous line showed, straight flight of the ink will be carried out.
[0079] Moreover, if it energizes by V4>V3 as shown in drawing 10 (c), as previous drawing 6 (c) showed, a little discharge direction of ink will shift to the left.
[0080] Thus, the discharge direction of ink is controllable by changing the electrical potential difference impressed to two regurgitation heaters 3 and 4.
[0081] Below, drawing 11 shows the example of concrete circuitry of the heater drive circuit for changing at random the applied voltage about two heaters 3 and 4 of one ink nozzle 10 mentioned above. Drawing 12 is a timing diagram which shows the various signals used in the circuit of drawing 11 .
[0082] Also in this heater drive circuit to a single-shot trigger circuit 25 The signal which specifies the pulse width of the heater driving pulse signal DP outputted from the printing data DT in which turning on and off of the dot concerned is shown, and the heat pulse width setting circuit 26, The regurgitation timing signal from the encoder 206 mentioned above is inputted, and a single-shot trigger circuit 25 outputs the heater driving pulse signal DP of the predetermined pulse width for recording the dot concerned, and a frequency (refer to drawing 12 (a)) based on these input signals.
[0083] This heater driving pulse signal DP is a signal for carrying out the on-off drive of the one heater about one ink nozzle as usual, and the common input of this heater driving pulse signal DP is carried out at the gate terminal of FET 20 and 21 which turns each heaters 3 and 4 on and off. That is, FET 20 and 21 is turned on and off by the heater driving pulse signal DP.
[0084] The random-number-generation circuits 30 and 31 generate the 1-bit random numbers RND1 and RND2 like the above, respectively (refer to drawing 12 (b) and (d)). These random-numbers outputs RND1 and RND2 are latched by FFs 34 and 35 to the start timing of the heater driving pulse signal DP, and are outputted as select signals R1 and R2 (refer to drawing 12 (c) and (e)).
[0085] A select signal R1 is inputted into the input data terminal D0 of the programmable power circuit 36 through an inverter 38, and is inputted into the input data terminal D0 of the programmable power circuit 37. The select signal R2 is inputted into the input data terminal D1 of the programmable power circuits 36 and 37. The programmable power circuits 36 and 37 lower the pressure of the input power electrical potential difference Vhh according to the condition of "H" "L" of the data input terminals D0 and D1 of being inputted into select signals R1 and R2 they to be [three any of different electrical-potential-difference Vh+, Vh, and Vh-], and are outputted. It is Vhh>Vh+>Vh>Vh-, for example, is referred to as Vhh=12v, Vh+=10.2v, Vh=10.1v, and Vh-=10.0v.
[0086] The programmable power circuits 36 and 37 operate as follows.
[0087] By input data terminal D0= "L", it becomes output voltage V0=Vh- at the time of D1= "L."
[0088] By input data terminal D0="H", it becomes output voltage V0=Vh+ at the time of D1= "L."
[0089] At the time of input data terminal D1="H", it is set to output voltage V0=Vh regardless of D1.
[0090] The output voltage V3 and V4 of the programmable power circuits 36 and 37 is connected to the drain terminal of FET through heaters 3 and 4, respectively.
[0091] Therefore, according to select signals R1 and R2, the applied voltage V3 and V4 of heaters 3 and 4 changes as follows (refer to drawing 12 (f) - (i)).

Condition (a) -- When R2 is "L" in R1="H", electrical-potential-difference Vh+ is impressed to a heater 3, and electrical-potential-difference Vh- is impressed to a heater 4.
[0092] Condition (b) -- When R2 is "H" in R1="H", an electrical potential difference Vh is impressed to a heater 3, and an electrical potential difference Vh is impressed to a heater 4.
[0093] Condition (c) -- When R2 is "L" in R1= "L", electrical-potential-difference Vh- is impressed to a heater 3, and electrical-potential-difference Vh+ is impressed to a heater 4.
[0094] In this operation gestalt, from the random-number-generation circuits 30 and 31 thus, by generating a 1-bit random number and changing the applied voltage of two heaters 3 and 4 driven to coincidence based on this random number Since the ink discharge direction of two or more nozzles with which the recording head 1 was equipped is changed intentionally at random for every dot of a main scanning direction, the record image of the same image quality as a multi-pass can be obtained substantially, without performing multi-pass printing.
[0095] The [3rd operation gestalt] Below, the 3rd operation gestalt of this invention is explained according to drawing 13 - drawing 15 .
[0096] preparing the quiescent time (OFF time amount) in the energization pulse added to two heaters 3 and 4 with this 3rd operation gestalt, as shown in drawing 13 -- 2 -- the resistance welding time of these heaters 3 and 4 is changed, and, thereby, the discharge direction of ink is changed within the specified quantity.
[0097] If the hits of the energization are carried out while energizing one heater 4 as shown in drawing 13 (a), since growth of a bubble became large from the heater 4 side, as the direction of a heater 3 side showed by previous drawing 6 (a), the discharge direction of ink will shift to the right for a while.
[0098] Moreover, if the resistance welding time is made the same as shown in drawing 13 (b), as previous drawing 6 (b) showed, and the continuous line showed, straight flight of the ink will be carried out.
[0099] Moreover, if the hits of the energization are carried out while energizing one heater 3 as shown in drawing 13 (c), since growth of a bubble became large, as the heater 4 side showed by previous drawing 6 (c) from the heater 3 side, a little discharge direction of ink will shift to the left.
[0100] Thus, the discharge direction of ink is controllable by changing the resistance welding time of two regurgitation heaters 3 and 4 by hits.
[0101] Below, drawing 14 shows the example of concrete circuitry of the heater drive circuit for changing at random the resistance welding time about two heaters 3 and 4 of one ink nozzle 10 mentioned above. Drawing 15 is a timing diagram which shows the various signals used in the circuit of drawing 14 .
[0102] Also in this heater drive circuit to a single-shot trigger circuit 25 The signal which specifies the pulse width of the heater driving pulse signal DP outputted from the printing data DT in which turning on and off of the dot concerned is shown, and the heat pulse width setting circuit 26, The regurgitation timing signal from the encoder 206 mentioned above is inputted, and a single-shot trigger circuit 25 outputs the heater driving pulse signal DP of the predetermined pulse width for recording the dot concerned, and a frequency (refer to drawing 15 (a)) based on these input signals.
[0103] This heater driving pulse signal DP is a signal for carrying out the on-off drive of the one heater about one ink nozzle as usual, and is making two driving pulse signals DP3 and DP4 (drawing 15 (j), (k)) from which the resistance welding time for driving two heaters 3 and a heater 4 differs by the circuitry of the following newly prepared in from a single-shot trigger circuit 25 before FET 20 and 21.
[0104] The heater driving pulse signal DP outputted from a single-shot trigger circuit 25 is inputted into the data terminal of FF27. The clock signal ck (refer to drawing 15 (b)) of 2Mhz(es) is inputted into the clock terminal of three steps of FFs 27, 28, and 29.
[0105] therefore -- a heater -- a driving pulse -- a signal -- DP -- FF -- 27 -- 28 -- 29 -- one -- a clock period -- a part -- having shifted -- timing -- latching -- having -- ******** -- consequent -- FF -- 27 -- 28 -- and -- 29 -- from -- 500 -- ns (1/2MHz) -- only -- starting -- timing -- having shifted -- a pulse signal -- DP -- one -- DP -- two -- and -- DP -- two -- ' -- outputting -- having -- ******** (refer to drawing 9 (c), (d), and (e)) .

[0106] The random-number-generation circuits 30 and 31 generate the 1-bit random numbers RND1 and RND2, respectively (refer to drawing 9 (f) and (h)). These random-numbers outputs RND1 and RND2 are latched by FFs 32 and 33 to the start timing of the heater driving pulse signal DP, and are outputted as select signals R1 and R2 (refer to drawing 9 (g) and (i)).
[0107] AND gate 47 takes the AND of the output pulse signal DP 1 of FF27, and the output of a logic gate 45, and outputs the driving pulse signal DP 3 of a heater 3. AND gate 48 takes the AND of the output pulse signal DP 1 of FF27, and the output of a logic gate 46, and outputs the driving pulse signal DP 4 of a heater 4.
[0108] That is, although AND gates 47 and 48 output fundamentally the driving pulse signals DP3 and DP4 whose output pulse signals DP 1, its timing, and periods of FF27 correspond, it is controlled by the output of the logic gates 45 and 46 inputted into the input terminal of another side whether the pulse signal in which the momentary energization quiescent time in the middle of the driving pulse mentioned above (off time amount) was included outputs.
[0109] The output DP 2 of select signals 28 and FF [R1, R2, and] 29 and DP2' are inputted into logic gates 45 and 46.
[0110] The driving pulse signals DP3 and DP4 of heaters 3 and 4 are as follows according to the condition of select signals R1 and R2 (refer to drawing 15 (j) and (k)).
[0111] Condition (a) -- It is R1="H", and when R2 is "L", the driving pulse signal DP 1 is outputted to DP3 as it is. Moreover, the driving pulse signal DP 1 with which DP2 becomes off only when DP2' is "L" in "H" is outputted to DP4. Therefore, as for a heater 3, compared with a heater 4, that resistance welding time becomes long in this case.
[0112] Condition (b) -- When R2 is "H", regardless of R1, a signal DP 1 is chosen as DP3 and DP4 as it is. Consequently, heaters 3 and 4 are driven by the equal resistance welding time.
[0113] Condition (c) -- The driving pulse signal DP 1 with which it is R1= "L", and DP2 becomes off only when DP2' is "L" by "H" at DP3 when R2 is "L" is outputted. Moreover, the driving pulse signal DP 1 is outputted to DP4 as it is. Therefore, as for a heater 3, compared with a heater 4, that resistance welding time becomes short in this case.
[0114] Thus, by generating a 1-bit random number and changing the resistance welding time of two heaters 3 and 4 from the random-number-generation circuits 30 and 31 with this random number in the above-mentioned operation gestalt Since the ink discharge direction of two or more nozzles with which the recording head 1 was equipped is changed intentionally at random for every dot of a main scanning direction, the record image of the same image quality as a multi-pass can be obtained substantially, without performing multi-pass printing.
[0115] In addition, although an idle period is prepared the middle and the resistance welding time of two heaters 3 and 4 is changed with this 3rd operation gestalt, you may make it change the resistance welding time of two heaters 3 and 4 by changing the pulse width of the driving pulses DP3 and DP4 which drive two heaters 3 and 4 itself.
[0116] by the way, above-mentioned the 1- although it was made to change the discharge direction of ink with the 3rd operation gestalt, the direction, i.e., form conveyance direction, in which a nozzle is installed side by side, the side-by-side installation direction of two heaters is changed with the above-mentioned operation gestalt 90 degrees, and you may make it change the discharge direction of ink about the main scanning direction where carriage is scanned
[0117] Moreover, in each above-mentioned operation gestalt, although two heaters were formed in one ink nozzle, it is good also so that three or more heaters may be formed in one ink nozzle and the discharge direction of ink may be changed by energization control of the heater of these plurality.
[0118] Furthermore, in each above-mentioned operation gestalt, the periods to which a discharge direction is changed are arbitration, such as not only a 1-dot unit but a 2-dot unit, an a large number dot unit, 1 raster line unit, etc. Moreover, the period to which a discharge direction is changed may be made [at random, i.e., irregular, and] like the above-mentioned operation gestalt.
[0119] (in addition to this) In addition, especially this invention is equipped with means (for example, an electric thermal-conversion object, a laser beam, etc.) to generate heat energy as energy used also in an

ink jet recording method in order to make the ink regurgitation perform, and brings about the effectiveness which was excellent in the recording head of the method which makes the change of state of ink occur with said heat energy, and the recording device. It is because the densification of record and highly minute-ization can be attained according to this method.

[0120] About the typical configuration and typical principle, what is performed using the fundamental principle currently indicated by the U.S. Pat. No. 4723129 specification and the 4740796 specification, for example is desirable. Although this method is applicable to both the so-called mold on demand and a continuous system On the electric thermal-conversion object which is especially arranged corresponding to the sheet and liquid route where the liquid (ink) is held in the case of the mold on demand By impressing at least one driving signal which gives the rapid temperature rise which supports recording information and exceeds nucleate boiling Since make an electric thermal-conversion object generate heat energy, the heat operating surface of a recording head is made to produce film boiling and the air bubbles in the liquid (ink) corresponding to this driving signal can be formed by one to one as a result, it is effective. A liquid (ink) is made to breathe out through opening for regurgitation by growth of these air bubbles, and contraction, and at least one drop is formed. If this driving signal is made into the shape of a pulse form, since growth contraction of air bubbles will be performed appropriately instancy, the regurgitation of a liquid (ink) excellent in especially responsibility can be attained, and it is more desirable. As a driving signal of the shape of this pulse form, what is indicated by the U.S. Pat. No. 4463359 specification and the 4345262 specification is suitable. In addition, if the conditions indicated by the U.S. Pat. No. 4313124 specification of invention about the rate of a temperature rise of the above-mentioned heat operating surface are adopted, further excellent record can be performed.

[0121] As a configuration of a recording head, the configuration using the U.S. Pat. No. 4558333 specification and U.S. Pat. No. 4459600 specification which indicate the configuration arranged to the field to which the heat operation section other than the combination configuration (a straight-line-like liquid flow channel or right-angle liquid flow channel) of a delivery which is indicated by each above-mentioned specification, a liquid route, and an electric thermal-conversion object is crooked is also included in this invention. In addition, the effectiveness of this invention is effective also as a configuration based on JP,59-138461,A which indicates the configuration whose puncturing which absorbs the pressure wave of JP,59-123670,A which indicates the configuration which uses a common slit as the discharge part of an electric thermal-conversion object to two or more electric thermal-conversion objects, or heat energy is made to correspond to a discharge part. Namely, no matter the gestalt of a recording head may be what thing, it is because it can record now efficiently certainly according to this invention.

[0122] Furthermore, this invention is effectively applicable also to the recording head of the full line type which has the die length corresponding to the maximum width of the record medium which can record a recording device. As such a recording head, any of the configuration which fills the die length with the combination of two or more recording heads, and the configuration as one recording head formed in one are sufficient.

[0123] In addition, this invention is effective also when the thing of a serial type like an upper example also uses the recording head fixed to the body of equipment, the recording head exchangeable chip type to which the electric connection with the body of equipment and supply of the ink from the body of equipment are attained by the body of equipment being equipped, or the recording head of the cartridge type with which the ink tank was formed in the recording head itself in one.

[0124] Moreover, as a configuration of the recording device of this invention, since the effectiveness of this invention can be stabilized further, it is desirable to add the regurgitation recovery means of a recording head, a preliminary auxiliary means, etc. If these are mentioned concretely, a preheating means to heat using the capping means, the cleaning means, the pressurization or the suction means, the electric thermal-conversion object, the heating elements different from this, or such combination over a recording head, and an auxiliary discharge appearance means to perform the regurgitation different from record can be mentioned.

[0125] Moreover, although only one piece was prepared also about the class thru/or the number of a

recording head carried, for example corresponding to monochromatic ink, corresponding to two or more ink which differs in an others and record color or concentration, more than one may be prepared the number of pieces. That is, although not only the recording mode of only mainstream colors, such as black, but a recording head may be constituted in one as a recording mode of a recording device or the paddle gap by two or more combination is sufficient, for example, this invention is very effective also in equipment equipped with at least one of each of the full color recording mode by the double color color of a different color, or color mixture.

[0126] Furthermore, in addition, in this invention example explained above, although ink is explained as a liquid It is ink solidified less than [a room temperature or it], and what is softened or liquefied at a room temperature may be used. Or by the ink jet method, since what carries out temperature control is common as a temperature control is performed for ink itself within the limits of 30 degrees C or more 70 degrees C or less and it is in the stabilization regurgitation range about the viscosity of ink, ink may use what makes the shape of liquid at the time of use record signal grant. In addition, in order to prevent the temperature up by heat energy positively because you make it use it as energy of the change of state from a solid condition to the liquid condition of ink, or in order to prevent evaporation of ink, the ink which solidifies in the state of neglect and is liquefied with heating may be used. Anyway, ink liquefies by grant according to the record signal of heat energy, and this invention can be applied also when using the ink of the property which will not be liquefied without grant of heat energy, such as that by which liquefied ink is breathed out, and a thing which it already begins to solidify when reaching a record medium. The ink in such a case is good for a porosity sheet crevice or a through tube which is indicated by JP,54-56847,A or JP,60-71260,A also as liquefied or a gestalt which counters to an electric thermal-conversion object in the condition of having been held as a solid. In this invention, the most effective thing performs the film-boiling method mentioned above to each ink mentioned above.

[0127] Furthermore, in addition, as a gestalt of the ink jet recording device of this invention, although used as an image printing terminal of information management systems, such as a computer, the gestalt of the reproducing unit combined with others, a reader, etc. and the facsimile apparatus which has a transceiver function further may be taken.

[0128]

[Effect of the Invention] The muscle of a scanning direction, and the spots or the knot muscle for every scan which a nozzle gets twisted and is generated by the variation in ** ink discharge quantity can be abolished without reducing printing speed according to this invention, since he is trying to change the ink discharge direction of each ink nozzle intentionally at random as explained above.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
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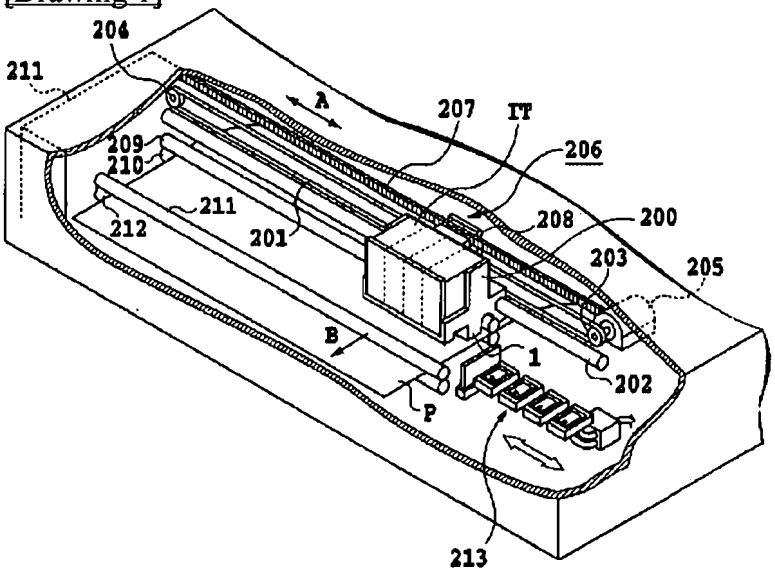
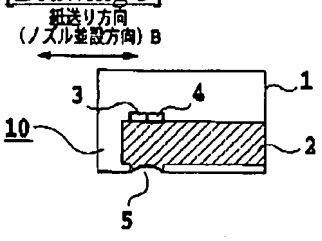
DRAWINGS

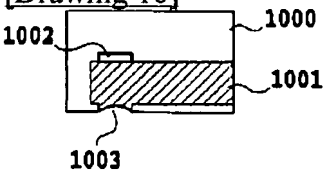
[Drawing 1]



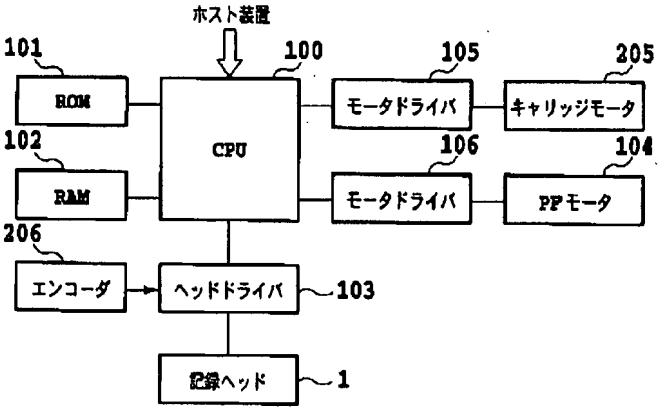
[Drawing 3]



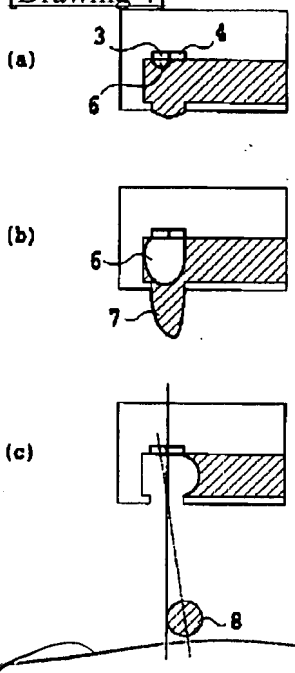
[Drawing 16]



[Drawing 2]



[Drawing 4]



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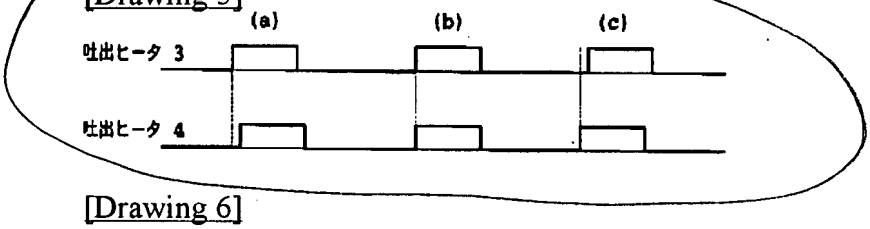

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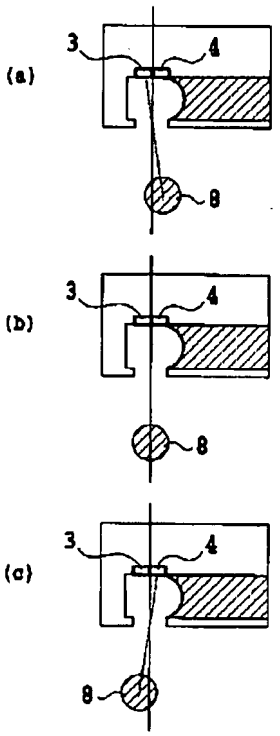
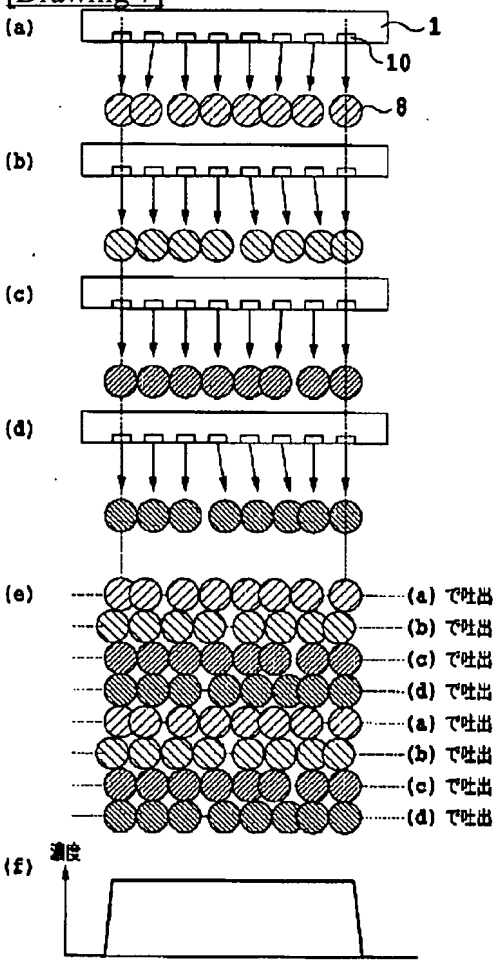
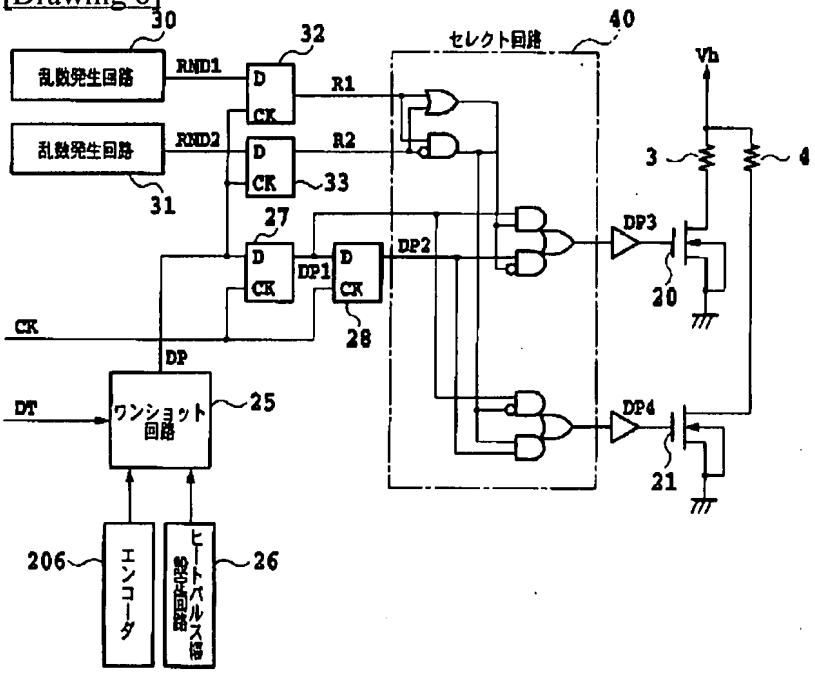

(a)
3
4
8
(b)
3
4
8
(c)
3
4
8

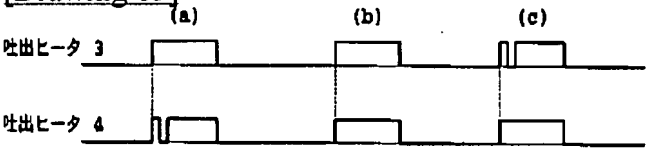
[Drawing 7]


(a)
1
10
8
(b)
(c)
(d)
(e)
(a) で吐出
(b) で吐出
(c) で吐出
(d) で吐出
(a) で吐出
(b) で吐出
(c) で吐出
(d) で吐出
(f)
濃度

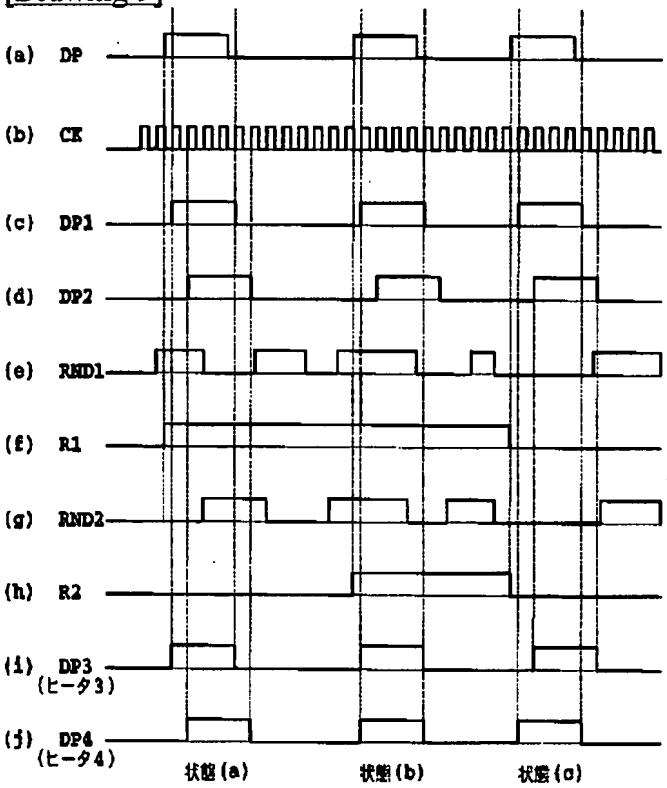
[Drawing 8]



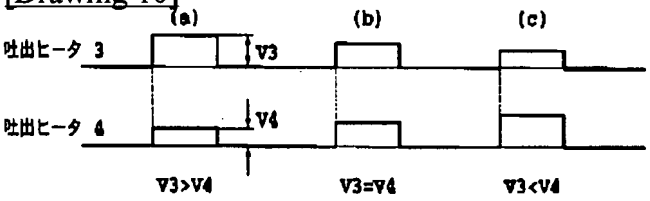
[Drawing 13]



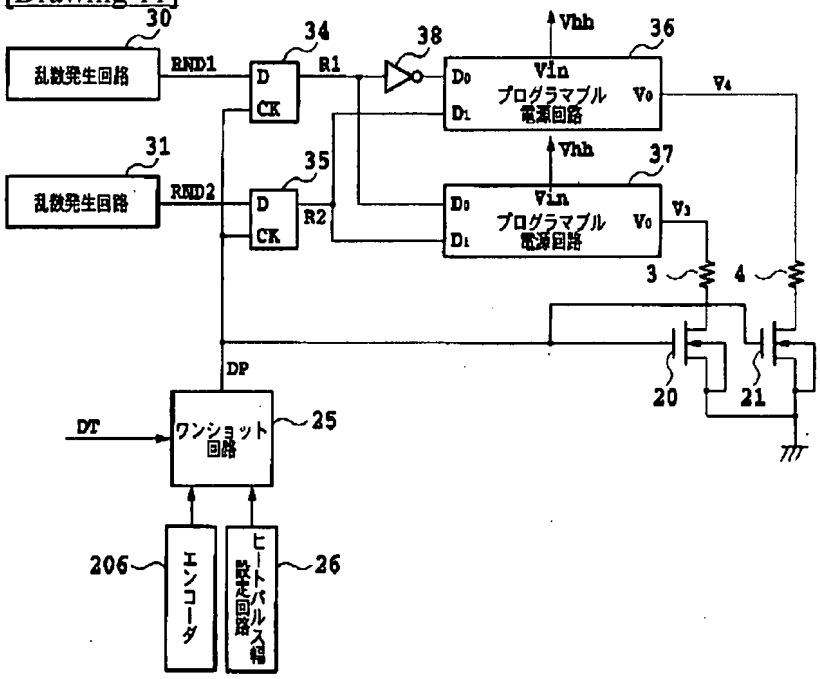
[Drawing 9]



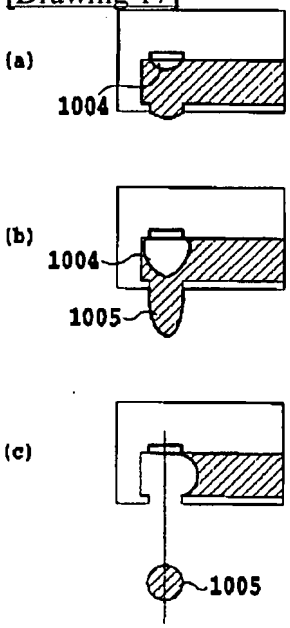
[Drawing 10]



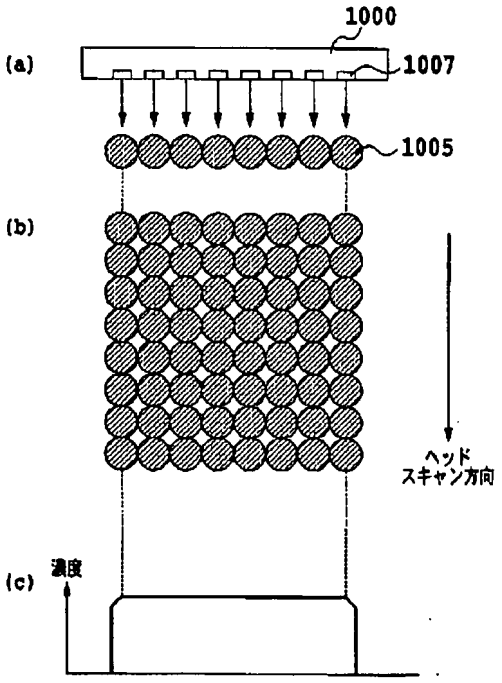
[Drawing 11]



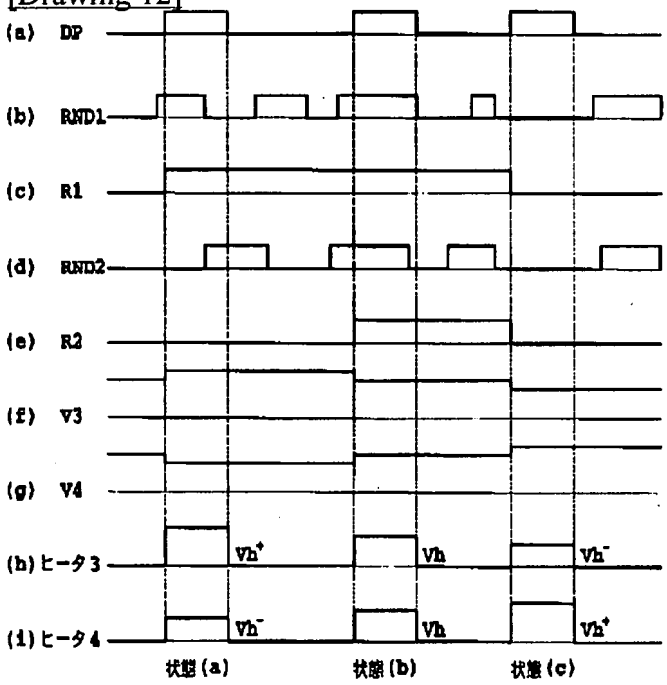
[Drawing 17]



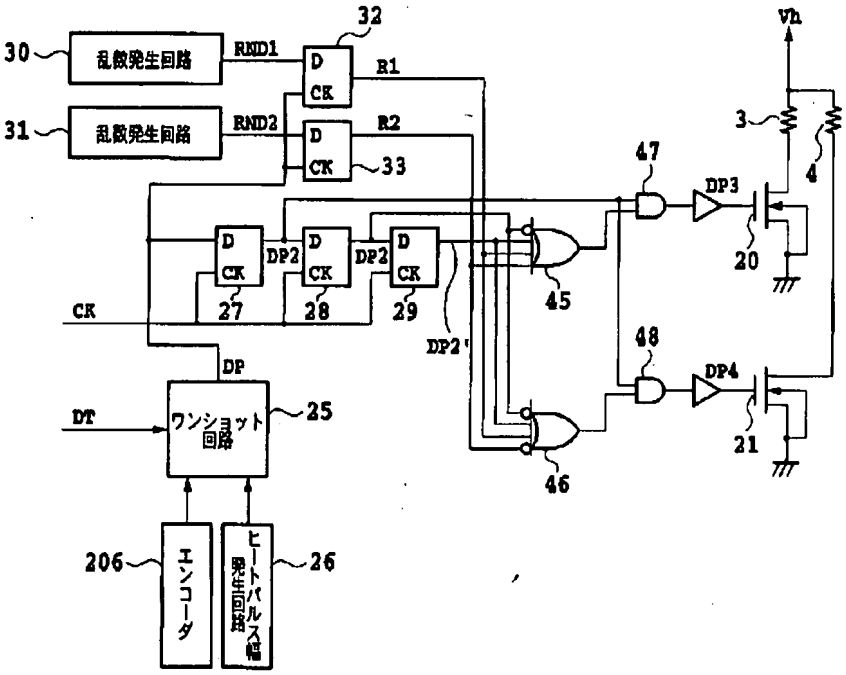
[Drawing 18]



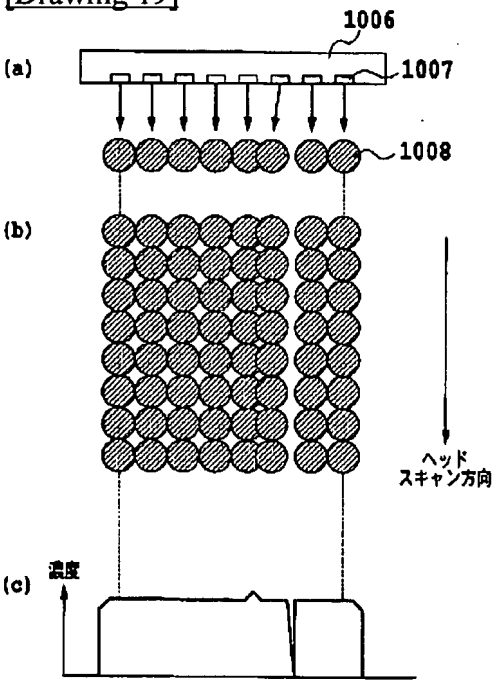
[Drawing 12]



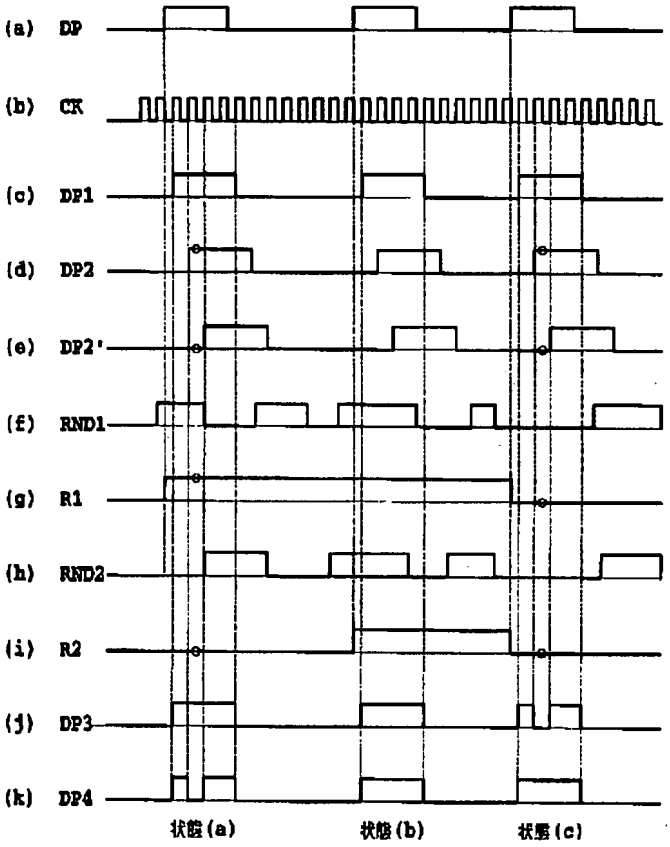
[Drawing 14]



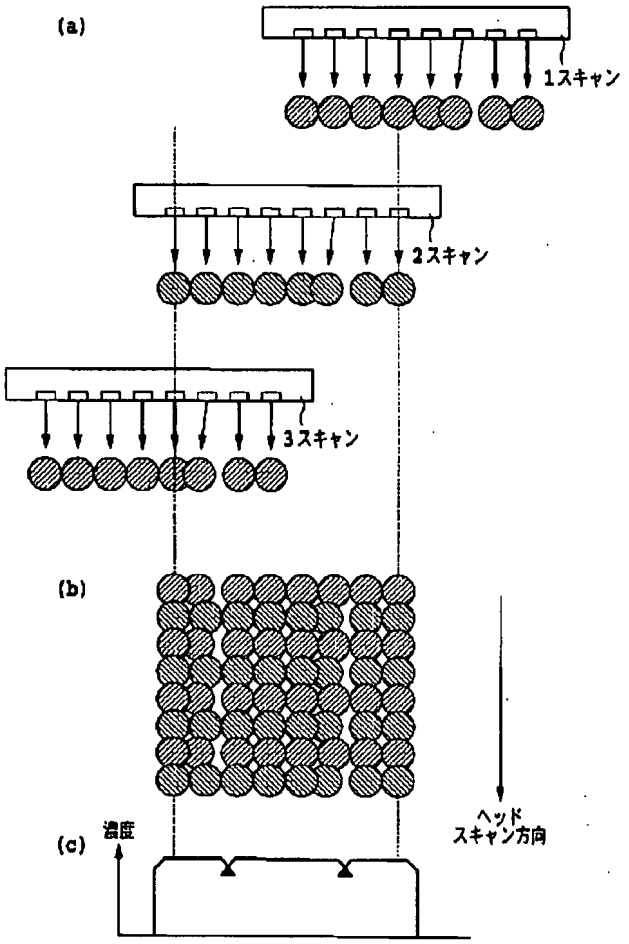
[Drawing 19]



[Drawing 15]


(a) DP
(b) CK
(c) DP1
(d) DP2
(e) DP2'
(f) RND1
(g) R1
(h) RND2
(i) R2
(j) DP3
(k) DP4
状態(a)
状態(b)
状態(c)

[Drawing 20]



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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective view showing the general-view configuration of the ink jet recording device concerning this invention.
[Drawing 2] It is the block diagram showing the configuration of the control system of the ink jet recording apparatus concerning this invention.
[Drawing 3] It is the configuration **** Fig. of a recording head about the operation gestalt of the ink jet recording device concerning this invention.
[Drawing 4] It is drawing showing the situation of the ink regurgitation of the 1st operation gestalt.
[Drawing 5] It is the timing diagram which shows the drive wave of the regurgitation heater of the 1st operation gestalt.
[Drawing 6] It is drawing showing change of the discharge direction of the ink by the various heater driving pulses in the 1st operation gestalt.
[Drawing 7] It is drawing showing the change and the printing image of an ink discharge direction accompanying scanning actuation with the 1st operation gestalt.
[Drawing 8] It is the circuit block diagram showing the concrete example of a drive circuit of the 1st operation gestalt.
[Drawing 9] It is the timing diagram of the various signals of the circuit block diagram of drawing 8 .
[Drawing 10] It is the timing diagram which shows the drive wave of the regurgitation heater of the 2nd operation gestalt.
[Drawing 11] It is the circuit block diagram showing the concrete example of a drive circuit of the 2nd operation gestalt.
[Drawing 12] It is the timing diagram of the various signals of the circuit block diagram of drawing 11 .
[Drawing 13] It is the timing diagram which shows the drive wave of the regurgitation heater of the 3rd operation gestalt.
[Drawing 14] It is the circuit block diagram showing the concrete example of a drive circuit of the 3rd operation gestalt.
[Drawing 15] It is the timing diagram of the various signals of the circuit block diagram of drawing 14 .
[Drawing 16] It is drawing showing the configuration of the conventional recording head.
[Drawing 17] It is drawing showing the situation of the ink regurgitation by the conventional recording head.
[Drawing 18] It is drawing showing the printing image by the ideal recording head.
[Drawing 19] It is drawing showing the printing image with which the white muscle was formed.
[Drawing 20] It is drawing explaining a multi-pass method.
[Description of Notations]
1 Recording Head
2 Ink Cavity
3 Heater (Electric Thermal-Conversion Object)
4 Heater (Electric Thermal-Conversion Object)

5 Ink Delivery
6 Bubble
8 Ink Droplet
10 Ink Nozzle
20,21 FET
25 Single-shot Trigger Circuit
30 31 Random-number-generation circuit
36 37 Programmable power circuit
100 CPU
200 Carriage

[Translation done.]